Biomedical Engineering Trends in Europe

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Views from the Guest Editors

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Since the end of the Second World War, European (re-) construction has been based on large-scale projects targeting well-identified challenges. The most symbolic is certainly the European coal and steel project, which stimulated the conception of the European unification and led to the Treaty of Rome of 1957. Other more recent initiatives contributing to the economic and industrial development of Europe include the European agriculture project and the joint European space venture, ESA. A more recent priority is the "Europe of knowledge," recognizing that the production, diffusion, and utilization of knowledge are the key ingredients for competitive productivity and sustained economic growth. Hence, the creation of a dynamic knowledge-based society within which education and training, research and development, and innovation play a critical role is one of the foremost objectives of Europe's structural reforms since 2000.

A prominent challenge in this endeavor is the health of European citizens and the sustainability of national healthcare systems. Confronted with increasing old age and a declining birth rate, health technologies must deal with the specific needs imposed by the extended age span of the population (from neonatal and pediatric to geriatric care) for support, prevention, diagnosis, and therapy. The need for enhancing the productivity of the working population (also by reducing the number of days for sick leave and curbing early retirement) and improving the quality of life of the elderly has to be balanced by the need for controlling the costs involved in the development of new health technologies, their implementation, and their utilization.

Biomedical engineering is the fastest growing engineering field. It is deeply rooted in the culture of interdisciplinary research and collaboration. It opens ways for exploring exciting frontiers in many scientific fields. By establishing collaboration and partnership, biomedical engineering is designated to play a key role in transforming and revolutionizing future medicine and healthcare practices. Biomedical engineering is more than a multidisciplinary approach. It is a new leading engineering discipline of the 21st century.

This special issue highlights European efforts in this field. The first three articles outline the regulatory, the biomedical engineering education, and the research and development environments, respectively. Pallikarakis and Moore present the European regulatory framework for medical devices. The article by Nagel et al. focuses on the biomedical engineering aspects in creating the European Higher Education Area. The contribution by Iakovidis et al. reviews European programs that support research and development in biomedical engineering and highlights its current focus—"biomedical informatics"— at the crossroads of biomedical engineering, medical informatics, and bioinformatics.

Hereafter, three examples of activities funded by the European Commission are presented. Lymberis and Dittmar give an overview of selected projects focusing on smart wearable health systems. Maojo and Tsiknakis review activities in biomedical informatics and Grid technologies. After that, de Kamps and Knoll summarize neuro-IT research activities.

European Union-funded research and development covers only a small fraction of the research and development done in Europe. The article by Dankelman et al. describes how various complementary technologies play a key role in advancing minimally invasive surgical interventions and training simulators. The section closes with an article by Siebes et al. outlining the benefits of the partnership initiative "Engineering for Health" that is being pursued by the recently created European-wide umbrella organization in our domain, the European Alliance for Medical and Biological Engineering and Science (EAMBES).

Lotfi Senhadji is a professor at the University of Rennes 1 with the Department of Electrical Engineering. He is the head of the INSERM research laboratory "Laboratoire Traitement du Signal et de l'Image (LTSI)." He received the Ph.D. from the University of Rennes 1, France, in signal processing and telecommunications in 1993. His main research efforts are focused on nonstationary signal processing with particular emphasis on wavelet transforms and time-frequency representations for detection, classification, and interpretation of biosignals (electrocardiography, electroencephalography, phonocardiography and NMR spectroscopy). He has been investigator of several grants in the field of health technology with public institutions or companies. He has published more than 70 research papers in journals and conferences and he contributed to four handbooks. He is a member of the council of the French Society of Biomedical Engineering (SFGBM), the French Alliance for Biomedical Engineering (AGBM), Senior Member of IEEE Engineering in Medicine and Biology Society, and the IEEE Signal Processing Society.

Maria Siebes received her M.S. (1984) and Ph.D. (1989) in biomedical engineering from the University of Southern California, Los Angeles. She then joined the biomedical engineering faculty at the University of Iowa, Iowa City, and

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Jos vander Sloten obtained his M.Sc. and Ph.D. in mechanical engineering from the Katholieke Universiteit Leuven in 1985 and 1990, respectively, specializing in biomechanics of the musculo-skeletal system. Currently, he is professor and chair of the Division of Biomechanics and Engineering Design at K.U. Leuven. He is teaching mechanics, problem solving and engineering design, and computer integrated surgery systems. He was elected programme director of the new Master in Biomedical Engineering program. He is a member of the council of the Belgian Society for Medical and Biological Engineering and Computing. In the European Alliance for Medical and Biological Engineering and Science (EAMBES), he served as secretary-general (2003–2004), president-elect (2005), and president (2006).

Niilo Saranummi received his D.Tech. in biomedical engineering at Tampere University of Technology in 1976. He is currently working as a research professor at VTT Technical Research Centre of Finland. He is co-founder and current chair of HL7 Finland. He is also editor -in-chief of the *IEEE Transactions of Information Technology in Biomedicine*. He has served as president of the International Federation for Medical and Biological Engineering (IFMBE), International Union for Physical and Engineering Sciences in Medicine (IUPESM), and European Alliance for Medical and Biological Engineering and Science (EAMBES). His research interests include pervasive healthcare, innovation, technology transfer, and technology policy setting in health technologies. He is a fellow of Finnish Academies of Technology, International Academy of Medical and Biological Engineering (IAMBE) and American Institute of Medical and Biological Engineering (AIMBE) and a Senior Member of IEEE.